

## Artículo Original / Original Article

### Anaemia among children living in land reform colonization projects in the Northeast region of Brazil: a population-based cross-sectional study

### Anemia en niños que viven en proyectos de colonización de reforma agraria en el nordeste de Brasil: un estudio transversal basado en la población

#### ABSTRACT

This study evaluated the prevalence of anaemia and its social determinants among Brazilian children from rural settlements of the land reform colonization projects of Teresina city, in Northeast, Brazil. This is a population-based cross-sectional study involving 131 children younger than 5 years. Anaemia was diagnosed by haemoglobin measurements using an automated haematology analyser. The prevalence of anaemia was 29%. Multiple Poisson regression showed that anemia prevalence decreased by 39% for each year of the child's age ( $aPR = 0.61$ ; 95%  $CI = 0.50 - 0.74$ ), 14% for each year of maternal education ( $aPR = 0.86$ ; 95%  $CI = 0.79 - 0.94$ ) and 6% for each year of maternal age ( $aPR = 0.94$ ; 95%  $CI = 0.89 - 1.00$ ). In addition, children living in clay or in unfinished masonry houses had a higher prevalence of anemia than those living in finished masonry houses ( $aPR = 2.73$ ; 95%  $CI = 1.50 - 4.97$ ). Anaemia is a moderate public health problem in rural land reform settlements in Teresina and is probably a health issue in other land reform colonization projects in Brazil and worldwide. Strategies that promote the economic and social development of this population need to be implemented, as well as strengthening the implementation of the National Iron Supplementation Program (Programa Nacional de Suplementação de Ferro). **Keywords:** Anaemia, Child; Infant; Rural Population; Social Determinants of Health.

#### RESUMEN

Este estudio evaluó la prevalencia de la anemia y sus determinantes sociales en niños brasileños de los asentamientos rurales de los proyectos de colonización de la reforma agraria de la ciudad de Teresina, nordeste de Brasil. Este es un estudio transversal basado en la población de 131 niños menores de 5 años. La anemia fue diagnosticada mediante mediciones de hemoglobina usando un analizador de hematología automatizado. La prevalencia de anemia fue del 29%. En un modelo múltiple, la prevalencia de anemia disminuyó 39% por cada año de edad infantil ( $aPR = 0.61$ ;  $IC\ 95\% = 0.50 - 0.74$ ), 14% por cada año de educación materna ( $aPR = 0.86$ ;  $IC\ 95\% = 0.79 - 0.94$ ) y 6% por cada año de edad materna ( $aPR = 0.94$ ;  $IC\ del\ 95\% = 0.89 a 1.00$ ). Además,

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los niños residentes en casas de de adobe o mampostería sin terminar presentaron una mayor prevalencia que los que viven en casas de mampostería terminada ( $aPR = 2.73$ ;  $IC\ 95\% = 1.50 - 4.97$ ). La anemia es un problema de salud pública moderado en los asentamientos de reforma agraria en Teresina y es probablemente un problema de salud en otros proyectos de colonización de la reforma agraria en Brasil y en todo el mundo. Se deben implementar estrategias que promuevan el desarrollo económico y social de esta población, así como fortalecer la implementación del Programa Nacional de Suplementación de Hierro (Programa Nacional de Suplementação de Ferro). **Palabras clave:** Anemia; Determinantes Sociales de la Salud; Población Rural; Niño; Lactante.

## INTRODUCTION

In Brazil, rural land reform settlements are agricultural properties arising from the government land reform colonization program, implemented by the National Institute for Colonization and Agrarian Reform (Instituto Nacional de Colonização e Reforma Agrária- INCRA). The program is designed for families without financial resources to acquire and maintain a rural property. The objectives are to secure workers to the acquired land, to promote economic development and establish community relationships<sup>1</sup>.

Although little is known about the health and nutritional situation of the population living in Brazilian rural land reform settlements, adversities related to the environment (drought, arid earth, frosts, and floods), in conjunction with the socioeconomic marginalization of this minority, render this population particularly prone to situations of hunger and food insecurity. Nutritional deficiencies such as anaemia, the primary nutritional problem found in children under the age of 5 years<sup>2,3,4</sup> worldwide may also be an issue in this population.

Anaemia has been associated with unfavourable social, environmental, economic, and even healthcare conditions<sup>5</sup>. Several national<sup>6,7</sup> and international studies<sup>8,9</sup> have demonstrated the influence of these variables in disease determination.

To our knowledge, there are no representative surveys regarding the prevalence of anaemia among children living in settlements of land reform colonization projects in the world. In Brazil, the only data available, were derived from a study conducted a decade ago (2004) in the Minas Gerais state, by Castro et al<sup>10</sup>, who found a 47.5% prevalence of anaemia. This prevalence suggests that the disease is an important public health problem in this population and exceeds the rate of 20.9% reported in the National Survey on Demography and Health of Women and Children (Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher- PNDS)<sup>11</sup> for children younger than 5 years.

In view of these considerations, studies investigating anaemia in children living in rural land reform settlements are opportune, highly relevant and may contribute to effective planning and implementation of public policies designed to improve the health and nutritional status of these children. The objective of the present study was to investigate the prevalence of anaemia among children living in rural settlements of land reform colonization projects in Teresina and its social determinants.

## MATERIALS AND METHODS

### Study area

Teresina is located in the northern region of the state of Piauí (Northeast Brazil). In 2010, the Human Development Index, Gini coefficient, mean per capita income and extreme poverty of the city were 0.75, 0.61, R\$757.56 (U\$445) and 4.4%, respectively<sup>12</sup>.

According to data from the General Coordination of the Implementation of INCRA/Piauí, Teresina had nine

rural settlements of the Brazilian land reform colonization project in 2012, which benefited 475 families.

### Study design and population

This was a population-based, cross-sectional, descriptive, analytical study involving children younger than 5 years of age, who lived in the rural settlements of land reform colonization projects in Teresina. All children younger than 5 years of age were invited to participate in the study and a total of 143 children were contacted. The rates of refusals and losses were 2.1% and 6.3%, respectively. The final sample thus consisted of 131 children (Figure 1). The main reasons for losses were the absence of the persons responsible for the children in the settlement and change of address during the data collection period.

### Data collection

Household interviews were conducted to obtain information about the socioeconomic conditions and food insecurity of the family. During the home visit, blood collection and application of a second interview were scheduled to assess characteristics of the children. These collections occurred within 3 weeks of the initial visit.

For anaemia diagnosis, a 2-mL venous blood sample was collected and analysed at the University Hospital of the Federal University of Piauí. Data were collected between May and October 2013.

The occurrence of anaemia in children was the outcome variable in the study. Haemoglobin (Hb) concentrations were determined with an automated haematology analyser (XS-1000i Sysmex™, Japan). Anaemia was defined as Hb < 9.4 g/dL and Hb < 10.3 g/dL (Saarinen standard)<sup>13</sup> for infants aged 2 months and 3 to 5 months, respectively, and as Hb < 11.0 g/dL (WHO)<sup>14</sup> for infants aged 6 to 59 months.

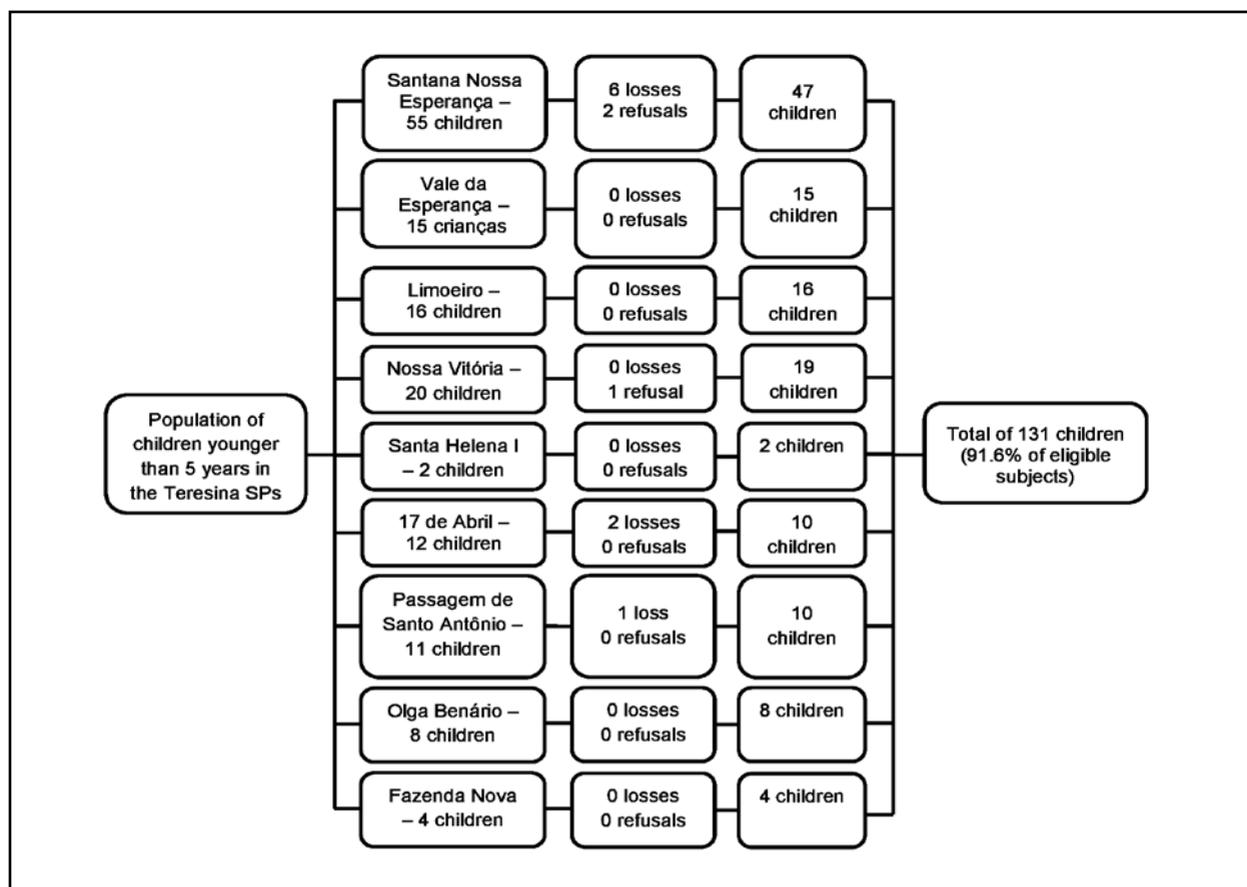
Food insecurity was evaluated using the Brazilian Food Insecurity Scale validated for Brazil by Perez-Escamilla and Segall-Correa<sup>15</sup>.

### Statistical analysis

Initially, potential factors predisposing the occurrence of anaemia were identified using Pearson's chi-square ( $\chi^2$ ) or Fisher's exact test for qualitative variables, and the Student t-test or Mann-Whitney to compare the means or medians, respectively, for quantitative variables. The Shapiro-Wilk test was used to test whether variables had a normal distribution.

In order to consider the clustering of children per family, Poisson regression with cluster option was used to test the association of the variables related to the characteristics of the family (Table 3). Poisson regression is a validated alternative for the calculation of adjusted prevalence ratios (aPR) in cross-sectional studies, when log-binomial regression presents convergence problems<sup>16</sup>.

The variables presenting an association at a level of  $p \leq 0.20$  in bivariate analysis were included in a multiple Poisson regression model. For this purpose, a manual stepwise forward technique for selection of variables was performed.



**Figure 1:** Selection of the population of children living in land reform colonization projects in Teresina, Piauí, Brazil.

A level of significance of 5% ( $p < 0.05$ ) were adopted for all variables. Data were analysed using Stata 11.0 software.

Considering that age is an important determinant of childhood anaemia<sup>17,18</sup>, and in this period there is a wide variation in Hb levels during the first 6 months of the child's life, increasing the number of false positives or false negatives in the diagnosis of anaemia, we used age-differentiated cut-off points to identify anaemia and controlled for age as a continuous variable in the regression model in order to minimize such effects. In addition, we performed secondary analysis (supplementary table) to obtain a multiple model, excluding children <6 months of age. In this analysis, it was observed that associations were maintained in both models, with or without children under 6 months. As a result, we kept children under 6 months in the main results presented.

#### Ethical considerations

The study obtained a letter of agreement from INCRA/Piauí and was approved by the Ethics Committee on Human Research of the Federal University of Piauí (Permit No. 383.869). The persons responsible for the children voluntarily signed the informed consent form.

#### RESULTS

The prevalence of anaemia was 29%. A higher prevalence of anaemia was observed among girls, but the difference was not statistically significant ( $p = 0.55$ ) as shown in table 1. Hb levels ranged from 5.8 to 14.5 g/dL, with a mean of 11.3 ( $\pm 0.6$ ) g/dL.

The variables that were significantly associated with anaemia in bivariate analysis were: child age, child attending a day-care centre/school, maternal education, per capita income, type of dwelling, number of rooms per dwelling, and number of persons per room ( $p < 0.05$ ) (Tables 2 and 3).

Table 4 shows the factors that remained associated with anaemia in the multiple Poisson regression model. A reduction of 39% in the prevalence of anaemia was observed for each year of child age ( $aPR = 0.61$ ; 95% CI= 0.50 – 0.74). Children living in mud or unfinished masonry houses presented a higher prevalence of anaemia than those living in finished masonry houses ( $aPR = 2.73$ ; 95% CI= 1.50 – 4.97). Prevalence of anaemia decreased by 14% for each year of maternal education ( $aPR = 0.86$ ; 95% CI= 0.79 – 0.94) and 6% for each year of maternal age ( $aPR = 0.94$ ; 95% CI= 0.89 - 1.00).

The variables "total breastfeeding", "attendance at a daycare centre/school", "sex of the head of household", "size of the household", "per capita income", "number of rooms per

dwelling", "number of persons per room" and "food insecurity" were no longer significantly associated with anaemia in the final Poisson regression model.

**Table 1.** Prevalence of anaemia among children from the Teresina Settlements Projects, according to sex.

Anaemia*	Girls		Boys		Total		p-value <sup>a</sup>
	N	%	N	%	N	%	
Non-anaemic	51	68.9	42	73.7	93	71.0	0.551
Anaemic	23	31.1	15	26.3	38	29.0	
Total	74	100.0	57	100.0	131	100.0	

<sup>a</sup> Pearson's chi-squared test. \*Anaemia was defined as Hb < 9.4 g/dL and Hb < 10.3 g/dL (Saarinen standard) for infants aged 2 months and 3 to 5 months, respectively and as Hb < 11.0 g/dL (WHO) for infants aged 6 to 59 months.

**Table 2.** Anaemia among children living in the Teresina Settlement Projects according to child characteristics.

Variable	Anaemia*				p-value
	Yes (n= 38)		No (n= 93)		
	n (%)	median (IQR)	n (%)	median (IQR)	
Age (years)		1 (0.7 - 1.9)		2.83 (1.7 - 4.1)	<0.001 <sup>a</sup>
Sex of the child					
Female	23 (31.1)		51(68.9)		0.551 <sup>b</sup>
Health problems					
Diarrhoea	2 (28.6)		5 (71.4)		0.311 <sup>c</sup>
Vomiting	3(60.0)		2 (40.0)		
Parasitosis	2 (40.0)		3 (60.0)		
Respiratory disease	20 (29.0)		49 (71.0)		
Exclusive breastfeeding (months)					
< 6	18 (29.0)		44 (71.0)		0.610 <sup>c</sup>
6	1 (14.3)		6 (85.7)		
> 6	19 (32.2)		40 (67.8)		
Total breastfeeding (months)					
< 6	8 (26.7)		22 (73.3)		0.095 <sup>b</sup>
6-12	16 (43.2)		21 (56.8)		
> 12	14 (23.0)		47 (77.0)		
Child attending a daycare centre/school					
Yes	5 (9.8)		46 (90.2)		<0.001 <sup>b</sup>
Have a brother/sister					
Yes	63 (74.1)		22 (25.9)		0.284 <sup>b</sup>

<sup>a</sup> Mann-Whitney test. <sup>b</sup> Pearson's chi-squared test. <sup>c</sup> Fisher's exact test. \*Anaemia was defined as Hb < 9.4 g/dL and Hb < 10.3 g/dL (Saarinen standard) for infants aged 2 months and 3 to 5 months, respectively and as Hb < 11.0 g/dL (WHO) for infants aged 6 to 59 months.

**Table 3.** Anaemia\* among children living in the Teresina Settlement Projects according to family characteristics.

Variable	Anaemia*		No (n= 93)		p-value <sup>a</sup>
	Yes (n= 38) n (%)	Median (IQR)	n (%)	Median (IQR)	
Sex of the head of household					
Male	32 (33.0)		65 (67.0)		0.102
Household size (persons)		4.5 (3 - 6)		4 (3 - 6)	0.122
Maternal age (years)		24 (21 - 28)		26 (23-30)	0.116
Maternal education		6.5 (4-8)		8 (5-10)	0.027
Paternal education		7 (3-9)		8 (4 - 11)	0.830
Per capita income		164.9 (94.8 – 226.0)		175.5 (133.3 – 271.2)	0.013
Government support					
Yes	30 (31.6)		65 (68.4)		0.311
Type of dwelling					
Finished masonry	10 (14.9)		57 (85.1)		0.001
N° of rooms per dwelling		5 (3 – 6)		5 (5 – 6)	0.032
N° of persons/room		1.08 (0.8 – 1.67)		1 (0.67 – 1.2)	<0.001
Public trash collection					
Yes	17 (27.9)		44 (72.1)		0.785
Food insecurity <sup>b</sup>					
Food security	19 (23.5)		62 (76.5)		0.084
Food insecurity	19 (38.0)		31 (62.0)		

<sup>a</sup> Adjusted by family as cluster unity using Poisson regression. <sup>b</sup> Food insecurity= moderate and severe food insecurity; Food security= food security and mild insecurity. \*Anaemia was defined as Hb < 9.4 g/dL and Hb < 10.3 g/dL (Saarinen standard) for infants aged 2 months and 3 to 5 months, respectively and as Hb < 11.0 g/dL (WHO) for infants aged 6 to 59 months.

**Table 4.** Determinants of anaemia\* in children younger than 5 years of age living in the Teresina Settlement Projects<sup>a</sup>.

Variable	aPR (95% CI)	p-value <sup>b</sup>
Child age (years)	0.61 (0.50 – 0.74)	<0.001
Type of dwelling		
Finished masonry	1	0.001
Mud or unfinished masonry	2.73 (1.50 – 4.97)	
Maternal education (years)	0.86 (0.79 – 0.94)	<0.001
Maternal age (years)	0.94 (0.89 – 1.00)	0.039

<sup>a</sup>Estimated by Poisson regression: adjusted prevalence ratio (aPR) and 95% confidence interval (CI). <sup>b</sup>p-value: probability of significance of the Poisson regression. \*Anaemia was defined as Hb < 9.4 g/dL and Hb < 10.3 g/dL (Saarinen standard) for infants aged 2 months and 3 to 5 months, respectively and as Hb < 11.0 g/dL (WHO) for infants aged 6 to 59 months.

## DISCUSSION

In terms of epidemiological importance, the prevalence of anaemia in the group investigated (29%) can be classified as a moderate public health problem according to the WHO classification<sup>17</sup> (percentage within 20 to 39.9%). Furthermore, comparison of this rate with data from the 2006 PND<sup>11</sup> obtained for children under 5 years of age in Brazil (20.9%) and in the Northeast region (25.5%) shows that the problem of anaemia among children living in rural land reform settlements in Teresina follows the trend in the magnitude of the national survey.

Comparison of the prevalence of anaemia between children from the Teresina rural land reform settlements in Piauí state, Brazil, and children from other developing countries such as India (69.5%)<sup>19</sup>, Cape Verde, Africa (51.8%)<sup>20</sup> and Mexico (26.9%)<sup>21</sup> showed a better epidemiological situation for the population studied here, which followed the same trend in magnitude as observed in Mexico (North America). It should be noted that, according to WHO data<sup>17</sup>, the Asian and African continents have the highest global prevalence of anaemia among children.

With respect to anaemia in the paediatric population of rural land reform settlements, the present study found a lower prevalence of anaemia (29%) than that reported by Castro et al (47.5%)<sup>10</sup>. The lower prevalence of anaemia in our study might be due to national social and health initiatives, such as the "Bolsa Família", a family grant program set up in 2003 in Brazil. Data from the Institute of Applied Economic Research, showed that per capita income grew by more than 40% between 2003 and 2011, from about R\$ 550.00 to just over R\$ 770.00. Income inequality measured by the Gini coefficient decreased by 9.2%, from 0.576 to 0.523. Extreme poverty fell by 8% to just over 3% and poverty declined from 16% to 6%<sup>22</sup>.

Internal policies of INCRA may have also contributed to reduce anaemia in these rural land reform settlements (construction of houses and increasing access to credit). However, it is important to emphasize that the prevalence of anaemia among the children investigated continues to be a public health problem, although not severe<sup>1</sup>.

According to Scopinho<sup>23</sup> although public policies related to agrarian reform in Brazil reduces the poverty level of these workers, they do not contribute in an effective manner to reduce social inequality or to strengthen the political autonomy of these subjects. This fact highlights the importance of nutritional surveillance of this group because of their risk of food insecurity and nutritional deficiencies related to unsatisfactory living conditions in rural land reform settlements.

Similar to other studies<sup>6,7,24</sup> younger age was a risk factor for the occurrence of anaemia. This finding can be explained by the intense growth of the child, which requires a greater supply of nutrients including iron, as well as by inadequate eating habits and early weaning of the child<sup>5,9</sup>.

The observation of a higher prevalence of anaemia among children living in mud or unfinished masonry houses can

be explained by a greater vulnerability to the dissemination of infectious and parasitic diseases, which are associated with episodes of microhaemorrhage<sup>25</sup>. Furthermore, this higher prevalence of anaemia reflects the socioeconomic situation of the family<sup>5,6</sup>.

Similar to other studies, there was a strong relationship between the educational level of the parents, particularly maternal education<sup>9,19,26</sup> and anaemia in children.

The higher risk for the occurrence of anaemia in children born to younger mothers, corroborates the finding of Zuffo et al<sup>27</sup>, where children born to woman younger than 28 years old were at higher risk for anaemia. The association between these variables can be explained by inexperience and lack of knowledge of these women regarding child care and choices made related to complementary infant feeding<sup>6,27</sup>.

A limitation of this study is the fact that the aetiology of anaemia was not investigated. However, according to WHO<sup>17</sup>, 50-90% of all cases of anaemia are a consequence of iron deficiency.

## CONCLUSIONS

Anaemia is a moderate public health problem among children living in rural land reform settlements in Teresina and is probably a health issue in other land reform colonization projects in Brazil and worldwide.

The damage caused by this nutritional disorder to the health of the child should make this condition a priority, suggesting the adoption of national programs designed to implement food and nutritional security policies and within the public health system (Unified Health System - "Sistema Único de Saúde" - SUS), strengthen the application of the National Iron Supplementation Program (Programa Nacional de Suplementação de Ferro). This consists of universal iron supplementation in prophylactic doses; mandatory fortification of iron and folic acid in wheat and maize flour; fortification with powdered micronutrients in prepared foods for children; and the promotion of adequate and healthy eating in order to increase the consumption of iron source foods.

Furthermore, proposals and strategies that promote the economic and social development of this population need to be effectively implemented.

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